

Study of Network Design Considerations for Small Businesses

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Abstract

This paper investigates the logical and physical network design considerations for a small business. Moreover, the paper investigates how a business facing data consistency issues may address the issue by implementing a network design solution and how networks can be monitored and protected from security threats.

Part one of this paper investigates the networking solution and networking topologies. Part two discusses networking infrastructure such as the purchasing of necessary networking devices to centralize the businesses data communications and background and foreground services. Part three of this paper discusses various aspects of network and data communication monitoring using a networking tool provided by SolarWinds. The last section, part four investigates a security proposal for the businesses network and discusses data recovery, malware and authentication.

Keywords: Network Infrastructure, Network Architecture, Foreground & Background Services, Network Monitoring, Network Security

1. Introduction

This paper focuses on a network design proposal for a business located in a 60,000 square foot two-story warehouse. This work provides information on proposed topologies and their advantages & disadvantages, infrastructure design, choice of devices and cabling, foreground and background services, monitoring, and the security of the network. It is expected that the proposed infrastructure will increase the productivity, improve quality of service for customer satisfaction, and an improved system security.

1.1. Network Solution

Prior to the implementation of this solution, the business had thirteen stand-alone workstations causing severe data inconsistency issues. The Advanced Research Projects Agency Network (ARPANET) first published in 1967 was one of the first computers networks which used packet switching [1]. Since then, many network topologies have been invented. Anjum and Pasha [2] defines that the most commonly known network topologies are: bus, ring, star, mesh, tree and point-to-point. This paper focuses on the adaptation of an extended star topology (Figure 1). An extended star topology extends the star by the inclusion of one or more repeaters [3].

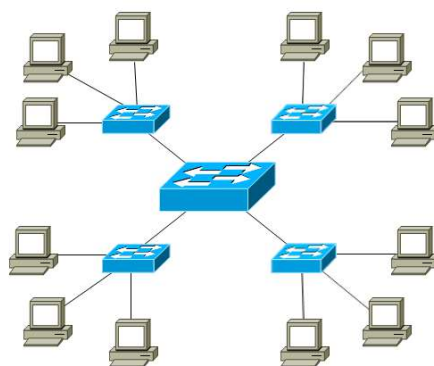


Figure 1: Extended star topology [4]

Winkelman [5] discusses the advantages and disadvantages of computer networking which are summarized below.

Advantages: User Access Control i.e. networks can control authorized permissions. Internet access can be provided to a set of connected devices. Client/Server operating systems permit printer, file and Database Management Systems to be shared. In the context of workgroups, collaborative software allows multiple users to work on projects concurrently. Software licenses are likely to be more inexpensive when compared to buying for several individual workstations.

Disadvantages: Installation, equipment and cabling can be expensive. Networks require administrative support. If important devices fail such as servers or central nodes, the entire network can be disconnected. Network cable breakages can cause connectivity issues and Viruses can spread throughout a network.

Data inconsistency issues can be resolved by installing a centralized network infrastructure. A server hosting a Database Management System (DBMS) can provide workstations throughout the network with data consistency. This is achieved by storing relevant data centrally all in one place that is worked on collaboratively.

Improved QoS can be achieved by the improvement of operations. Shared resources such as printing, emails, data and DBMS improves employee productivity and ameliorates operations. Customer orders can be processed more effectively as order information is available immediately without having to wait days before workstations are updated.

Businesses small or large, require uninterrupted connectivity in the context of their communication networks. Network monitoring tools permit for devices on the network to be monitored continuously. This

ensures that Security can be improved by restricting unauthorized access to data. For example, the accounts department information access can be made limited to the authorized staff using access control methods such as directory services. Firewalls, IPSs, and IDSs also play an important role in security.

It can be claimed that businesses in general and the business in this paper can benefit from a networking solution. The benefits provide improved operations, security, employee productivity and improved quality of service for customers.

Section two of this paper discusses the proposed networking solution for the business in this paper and the background and foreground services a network can provide. Section three discusses data communication tool called Solar winds which monitors network traffic and nodes. Part four discusses security, data, malware and authentication for networks.

2. Network Infrastructure

This section discusses the network infrastructure, design layouts, networking devices and cabling mediums to construct an extended star topology network for the business and background and foreground services.

2.1. Network Design

Section 2.1 provides a visual overview; costs and the layout of the networking devices recommended for the small company to centralize a network and secure their data using a wireless virtual local area network (VLAN). Figure 2 visualizes an extended star topology for the business to adopt. The itemizations of devices to build the network infrastructure are listed below.

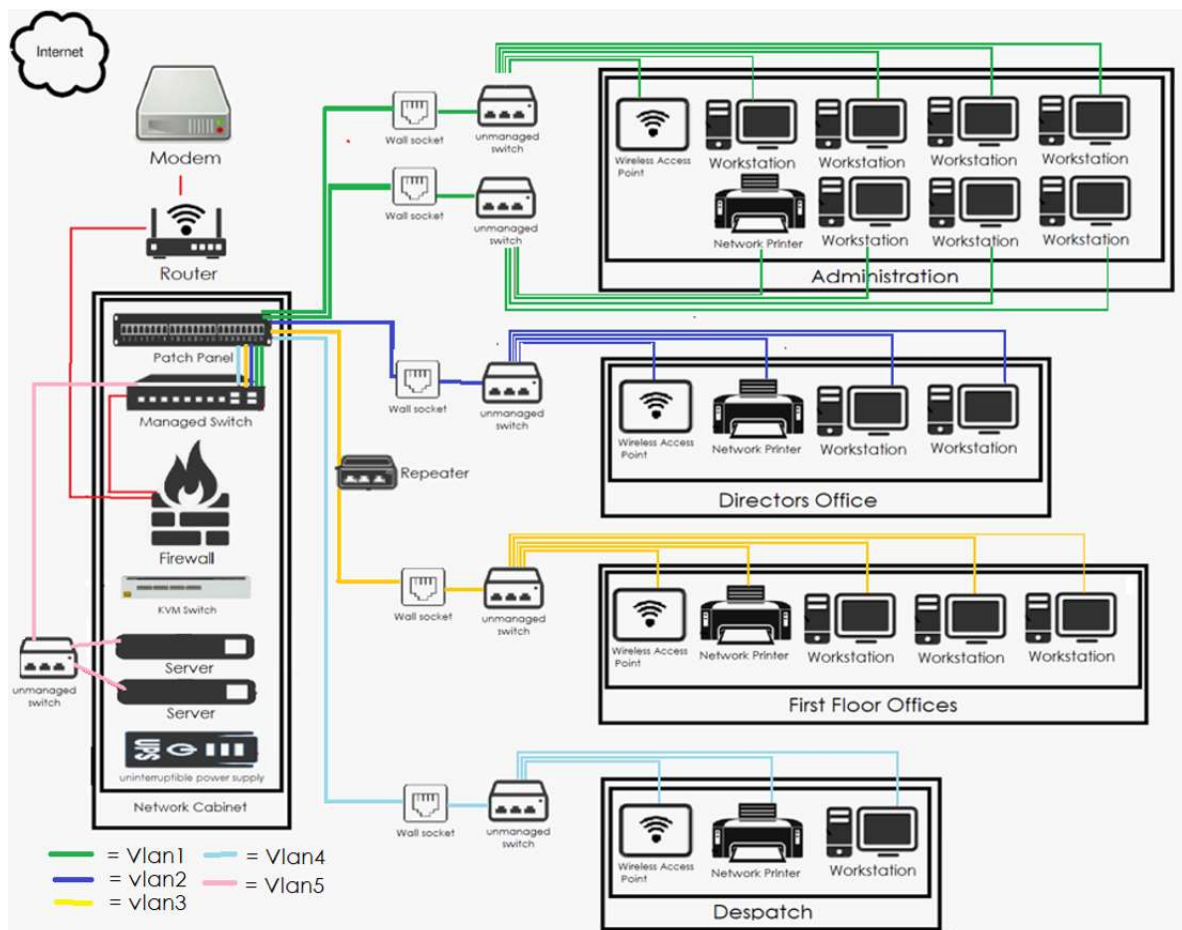


Figure 2: Infrastructure Design

Tables below provide specifications of various networking devices used in the infrastructure proposed above. The estimated device costs to build the infrastructure solution ranges between £6,422.00 and £24,995.00 depending on the items purchased. The pricing in the network devices Figures are accurate at the time of this paper's publication. The pricing structure is a good estimate however there is likely to be additional costs which are incurred.

2.2. Network Devices

a. Server Cabinet

A server cabinet is recommended to house and organise the businesses network devices in the computer room.

Table 1: Server Cabinet Specifications

Picture	Manufacturer	Part Number	Specifications	Cost	Supplier
	Rackyrax	RR-F5-27-M	600mm x 1000mm	£436.33	www.cablemonkey.co.uk/server-racks-cabinets/89936-rackyrax-600mm-x-1000mm-server-cabinet.html
	APC	AR3100	600 mm x 1070 mm	£954.14	www.serversdirect.co.uk/p/137924/apc-netshelter-sx-enclosure-with-sides-rack-4u

b. Patch Panel

A Patch panel is recommended for cable and circuit management. The device permits circuits by arranging Ethernet cables to be plugged in or out of the network.

Table 2: Patch Panel Specifications

Picture	Manufacturer	Part Number	Specifications	Cost	Supplier
	Connectix Cabling Systems	009-001-009-07	24 Port Rack-Mountable	£26.00	www.cablemonkey.co.uk/cat5e-patch-panels/9159-24-port-cat5e-utp-elite-port-patch-panel-5056045700387.html
	Connectix Cabling Systems	009-001-009-08	12 Port, Rack-Mountable	£30.00	www.cablemonkey.co.uk/10-patch-panels/9512-12-port-cat6-l0-utp-patch-panel.html

c. Managed Switch

Managed switches offer LAN traffic control. The device is recommended so data traffic can be managed and to also interconnect multiple devices.

Table 3: Managed Switch Specifications

Picture	Manufacturer	Part Number	Specifications	Cost	Supplier
	FS	S3900-48T4S	48 ports, 48 x 10/100/1000BASE-T + 4xSFP, Rack-mountable	£334.00	www.fs.com/uk/products/72946.html
	Cisco	SG350X-24-K9-EU	24-Port, 24x10/100/1000, PoE, Rack-mountable	£323.50	www.amazon.co.uk/UBIQUITI-Networks-EdgeSwitch-Managed-Gigaabit/dp/B0151HJYT

d. Firewall

A firewall helps to prevent unauthorised access to a network by controlling what traffic can be passed through. The device is recommended to help prevent unauthorised access from the internet.

Table 4: Firewall Specification

Picture	Manufacturer	Part Number	Specifications	Cost	Supplier
	Cisco	ASA5515-K9	Up to 1.2 Gbps of firewall throughput, Rack-Mountable	£567.85	www.techbuyer.com/asa5515-k9-cisco-asa-5515-x-firewall-edition-security-appliance-59082/
	Zyxel	VPN 50	up to 800Mbps of firewall throughput, not Rack-mountable	£340.82	www.amazon.co.uk/ZyWALL-800Mbps-Firewall-recommended-VPN50/dp/B0788BKR7S/ref=sr_1_1

e. Keyboard, Video and Mouse (KVM) Switch and Console

A KVM switch and console allows multiple computers to be controlled from one console. A KVM switch is recommended to provide direct access to devices in the computer room.

Table 5: KVM Specifications

Picture	Manufacturer	Part Number	Specifications	Cost	Supplier
	Aten	CL5708M	8 VGA Ports, Rack-mountable	£827.14	www.stuff-uk.net/p-2199929.aspx
	Tripp Lite	B001E96J1U	16 VGA Ports, Rack-mountable	£1,218.18	www.amazon.co.uk/Tripp-Lite-Controller-Rackmount-Console/dp/B001E96J1U/ref=sr_l_3

f. Server

Two servers are recommended to the business. One server is to host a DBMS and printers. The second server is to host file sharing, active directory, DNS, Web and Email. Servers provide services to computers on the network. The servers are recommended to improve data consistency and provide services.

Table 6: Server specifications

Picture	Manufacturer	Part Number	Specifications	Cost	Supplier
	Cisco	C240	High Core 2 Xeon E5-2680V4 2.4 GHz 64GB RAM 2U Rack Server, RAID (SAS 12Gb/s)	£5,267.94	www.ebuyer.com/757149-cisco-ucs-smartplay-select-c240-m4s-high-core-2-xeon-e5-2680v4-2-4-ucs-spr-c240m4-bc2
	Dell	R6V6G	R530 XEON E5-2603 V41.7 GHz, 8GB Ram, 1TB HD. Rack-Mountable.	£1,692.71	www.amazon.co.uk/Dell-R6V6G-PowerEdge-E5-2603V4-Server/dp/B071NRPFV/ref=sr_1_14

g. Uninterruptible Power Supply (UPS)

A UPS is recommended to help protect hardware from unexpected power failures. If the business has a power failure, the UPS provides power for a limited time.

Table 7: UPS specifications

Picture	Manufacturer	Part Number	Specifications	Cost	Supplier
	APC	BX700UI	700VA, Not Rack-Mountable.	£71.61	www.amazon.co.uk/APC-Back-UPS-BX-Uninterruptible-Shutdown/dp/B00T7BYV6W/ref=sr_1_1_sspa
	APC	SMT1500R MI2UC	Smart-UPS, 1500VA, Rack-Mountable.	£730.98	www.ebuyer.com/835281-apc-smart-ups-1500va-lcd-rm-l-kw-1500-va-with-apc-smt1500rmi2uc

h. Router

A router, routes traffic between LANs. Routers are capable of routing information from several networks and delivering the signals to computers. A Router is recommended so signals from the modem are routed to the network.

Table 8: Router specifications

Picture	Manufacturer	Part Number	Specifications	Cost	Supplier
	Cisco	RV340W	Wireless-AC Dual WAN Gigabit VPN Router	£239.96	www.senetic.co.uk/product/RV340W-E-K9-G5
	Cisco	4451-X	GiVgE, WAN, VPN, Rack-Mountable.	£7,771.97	www.ebuyer.com/725795-cisco-4451-x-router-isr4451-x-k9

i. Modem

The internet uses analogue signals whilst computers use digital signals. A modem provides internet services by demodulating incoming analogue signals into digital signals. A Modem is recommended to provide internet services.

Table 8: Modem specifications

Picture	Manufacturer	Part Number	Specifications	Cost	Supplier
	Motorola	SB6141	Download up to 343 Mbps. Upload speeds up to 131 Mbps.	£111.61	www.amazon.co.uk/Arris-Motorola-SurfBoard-SB6141-DOCSIS/dp/B00AJHDZSI/ref=sr_1_fmnull_1
	NET GEAR	CM400	Download up to 340Mbps. Upload up to 130 Mbps	£46.22	www.netgear.com/home/products/networking/cable-modems-routers/CM400.aspx

j. Repeater

Ethernet cables typically have data integrity up to 100m. A repeater rebroadcasts a signal to provide extra coverage. A Repeater is recommended to boost the signal between the computer room and despatch office.

Table 10: Repeater Specifications

Picture	Manufacturer	Part Number	Specifications	Cost	Supplier
	TRENDnet	TPE-E110	Gigabit, PoE+ Repeater up to 200m Extension. Daisy chain up to 7 units	£75.26	www.amazon.co.uk/StarTech-com-VDSL2-Ethernet-Extender-Single/dp/B0026MAX8E
	TRENDnet	TPE-E100	Gigabit, PoE+ Repeater Up to 200m Extension. Daisy Chain up to 3 units.	£53.49	www.amazon.co.uk/TRENDnet-TPE-E100-Gigabit-Repeater-Extension/dp/B00SDF66S0/ref=sr_l

k. Workstation

Workstations consist of a desktop computer, mouse, keyboard and monitor. The business for this paper already has workstations however; the items are recommended should the hardware need replacing.

Table 11: Workstation Specifications

Picture	Manufacturer	Part Number	Specifications	Cost	Supplier
	HP	Z8 G4	Workstation with Xeon (14 Core) & 64GB RAM	£4,378.80	https://store.hp.com/UKStore/Merch/Product.aspx?id=2WU50EA&opt=ABU&sel=WKS

	Dell	MVK84	23.8 Inch Monitor, Intel Core i3, 8 GB RAM, 1 TB HDD, Windows 10.	£649.00	www.amazon.co.uk/Dell-Inspiron-Silver-i3-8100T-Windows/dp/B07G4ST516/ref=sr_1_fmnull_1
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l. Networked Printer

A Network printer allows workstations to process printing jobs. A Networked printer is recommended so employees can print documents.

Table 12: Printer Specifications

Picture	Manufacturer	Part Number	Specifications	Cost	Supplier
	SAMSUNG	C430W	Colour, Simplex, LaserJet.	£99.99	www.currys.co.uk/gbuk/computing-accessories/printers-scanners-and-ink/printers/samsung-xpress-c430w-wireless-laser-printer-10135242-pdt.html
	Xerox	3610dn	Mono Laser Printer, Duplex, Network	£344.58	www.amazon.co.uk/Xerox-Phaser-3610dn-Printer-Network/dp/B00F1AV6YI/ref=sr_1_fmnull_3

m. Cable Socket Specification

Table 13: Cable Socket Specifications

Picture	Manufacturer	Part Number	Specifications	Cost	Supplier
	Connectix Cabling Systems	008-000-000-20	RJ45 1 Port Module	£2.50	www.cablemonkey.co.uk/cat6-modules-outlets/28-cat6-utprj45-module-euromod-size-5056045700257.html
	Kenable	B003OSRHNI	RJ45, 2 Port Module	£3.93	www.amazon.co.uk/signal-CS13673-Sockets-Double-Keystones/dp/B003OSRHNI/ref=sr_1_1

n. Wireless Access Point (WAP)

WAP allows for devices with wireless communication mediums such as wireless fidelity (Wi-Fi) to interconnect on a wired network. The device is recommended for wireless devices to connect to the network.

Table 14: WAP Specifications

Picture	Manufacturer	Part Number	Specifications	Cost	Supplier
	Zyxel	NWA1123-ACHD	1300 Mbps, 2.4 GHz - 5 GHz, wall/ceiling mountable, PoE+	£159.99	www.amazon.co.uk/Wireless-Density-Standalone-ManagedNWA1123-ACHD/dp/B076VM34PG/ref=sr_1_2_sspa
	TP-Link	EAP 115	300Mbps, 2.4GHz, PoE, Ceiling/Wall mounting	£30.67	www.cablemonkey.co.uk/tp-link-wireless-networks/58330-tp-link-eopl15-6935364096939.html

o. Unmanaged Switch

A switch provides additional ports so multiple devices can be connected to one device. A switch maps Media Access Control (MAC) addresses to ports so traffic is transmitted to correct devices. Switches are recommended to provide additional ports in offices.

Table 15: Unmanaged Switch Specifications

Picture	Manufacturer	Part Number	Specifications	Cost	Supplier
	TP-Link	TL-SG108E	8-Port Gigabit Unmanaged Switch	£22.78	www.amazon.co.uk/TP-LINK-TL-SG108-8-Ports-Ethernet-Wall-Mounting/dp/B00A121WN6/ref=sr12sspa
	NETGEAR	GS108UK	8 Port Gigabit Unmanaged Switch	£30.56	www.amazon.co.uk/NETGEAR-GS108UK-Gigabit-Ethernet-Unmanaged/dp/B0000E5SES/ref=sr13

2.3. Cabling

This section discusses cabling requirements and visualizes the cabling structure to interconnect networking devices together for the business' infrastructure solution. Figure 3 and 4 visualize the cabling lengths required.

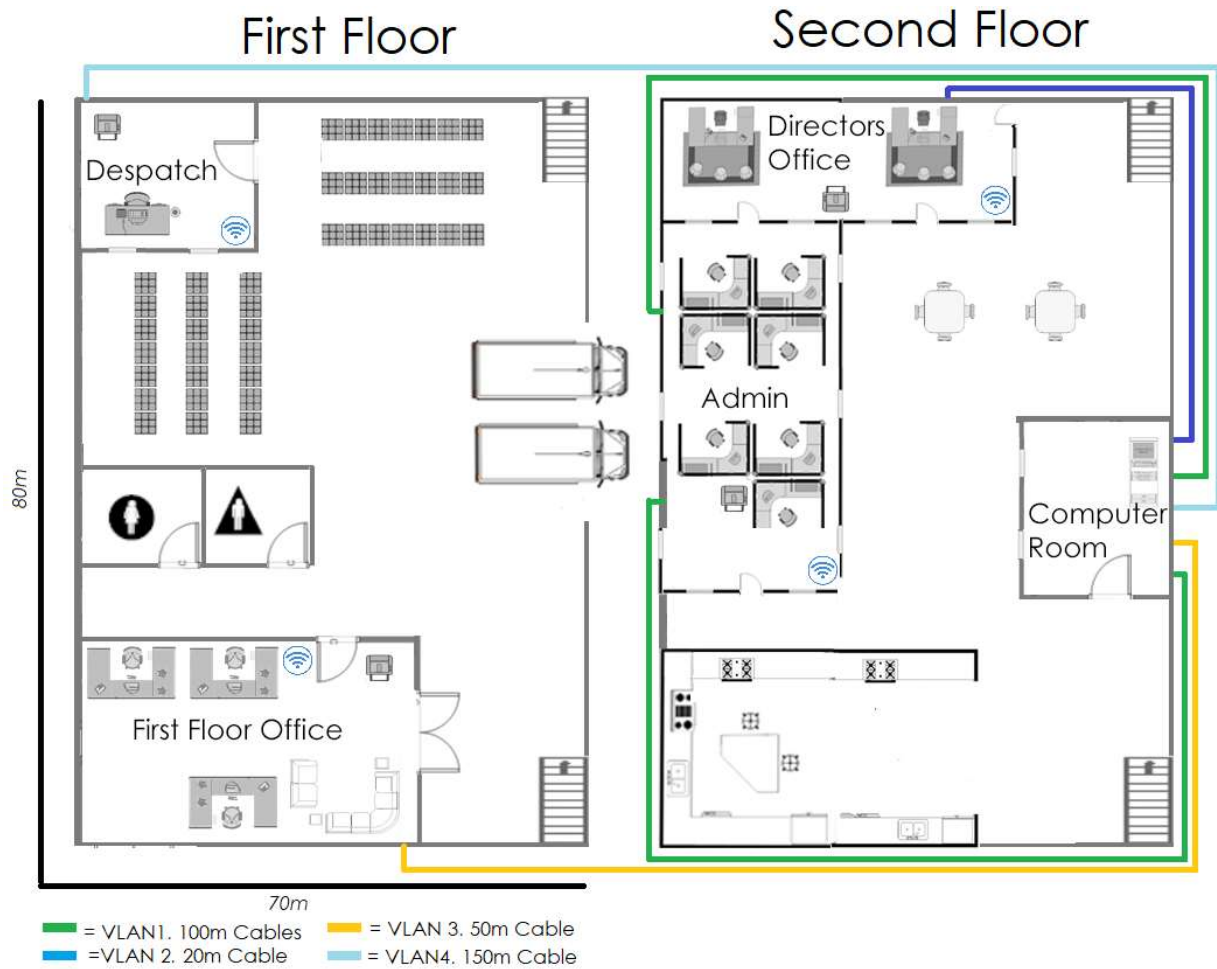


Figure 3: behind wall/fixings cabling

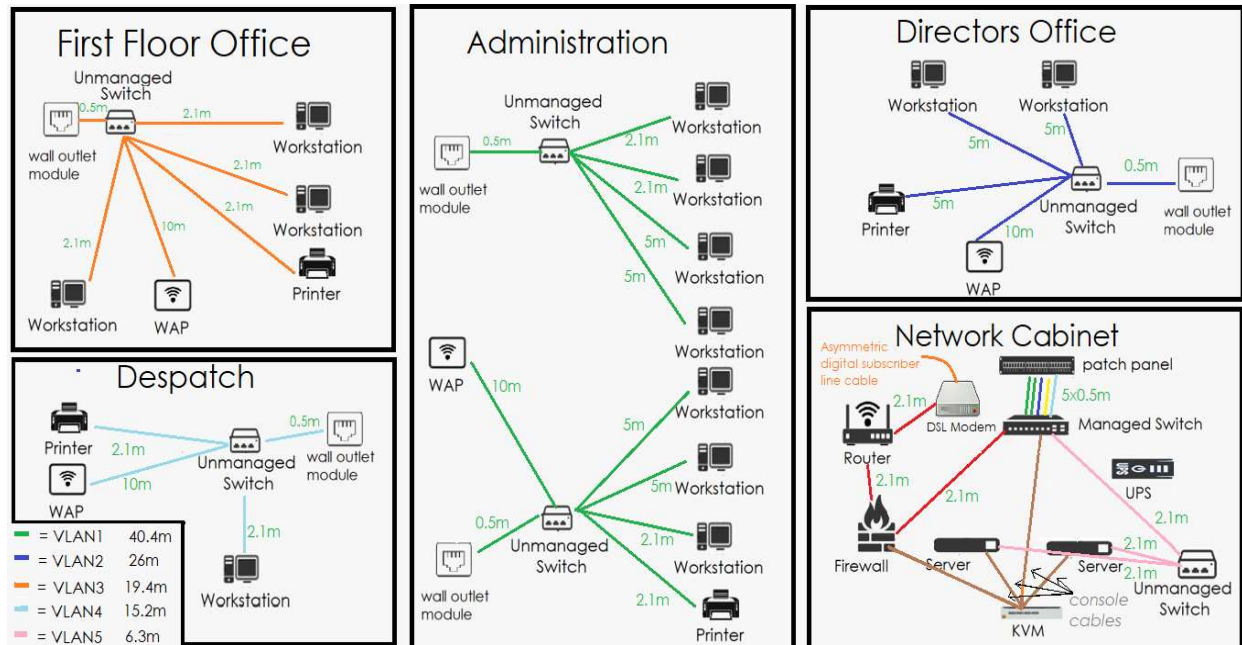


Figure 4: Room cabling

A wired connection is less prone to interference than wireless [6]. There are several transmission speeds of Ethernet category types. Fast Ethernet is up to 100 Megabits per second (Mbps). Gigabit Ethernet offers up to 1 Gigabits per second (Gbps) [7].

UTP and STP both have protection against electromagnetic and radio interference. However, UTP has extra shielding which results in an improve transmission integrity over UTP [5]. UTP cable is more flexible and cheaper but provides less protection than STP [8]. Cross-over cables should be used to connect two like devices together, straight through cables connect two different devices together [9]. However, Automatic medium-dependent interface crossover (auto-MDIX) on 10/100/1000-Mb/s modules do not need Cross-over cables to directly link like devices [10]. The recommended managed switches in this project have 10/100/1000-Mb/s modules making cross-over cables redundant for this project.

Straight-through STP Category 7 (Cat7) cabling is recommended for the cabling in Figure 6 for future proofing as the cable provides transmission speeds up to 10 Gigabit. The cables in Figure 6 are hidden behind fixtures and crawlspaces, installing the highest data rate cable, can be beneficial for future proofing. Straight-through STP Category 6 (Cat 6) cabling is recommended for the room cabling shown in Figure 7. This is recommended due to benefits from STP, and fast transmission speeds, making Cat6 enough for this project.

Figure 4 provides the itemized breakdown of the expenditure in relation to the cabling. Total cable and accessories cost come down to £ 419.12 (prices true at the time of publication of this paper).

Picture	Manufacturer	Part Number	Item	Cost	Quantity	Required Length	Total	Supplier
	TDA	TDA-48896	100m, Cat7, STP.	£64.36	4	320m	£257.44	www.amazon.co.uk/TDA-Ethernet-Halogen-Copper-Orange/dp/B01L4664N0/ref=sr_1_3
Cat7 for cabling in Figure 6.								
	Kenable	B07J1P2ZMG	50m, STP, Cat 6	£22.75	3	113.6m	£68.25	www.amazon.co.uk/kenable-External-SHIELDED-Outdoor-Ethernet/dp/B01HVT83K/ref=sr_1_3
Cat6 for cabling in Figure 7.								
	Hinocables	B00ESCCSUQ	Network RJ45 Crimping Crimp Tool	£5.49	1	N/A	£5.49	www.amazon.co.uk/rhinocables%C2%AE-Network-Ethernet-Crimping-Crimper/dp/B00ESCCSUQ/ref=sr_1_1_ssp
	UGREEN	20331	RJ45 Connector, 50 pcs.	£7.99	2	86pieces	£7.99	www.amazon.co.uk/UGREEN-Connector-Cat5e-Crimp-Plated/dp/B01EURRDW6/
Crimping tools and connectors.								
	Wfortune	B07CTHZB48	Console Cable, Cisco	9.99	4	N/A	39.96	www.amazon.co.uk/Console-Cable-Cisco-Rollover-Windows/dp/B07CTHZB48/ref=sr_1_1_sspa
Console cables for the KVM switch								
	Gain Express	N03NF8108-M	Cable Tester	£39.90	1	N/A	39.99	www.amazon.co.uk/Network-Coaxial-Length-Digital-Identifier/dp/B00MMYNMSO/ref=sr_1_7
Cable tester to ensure cables work.								

Figure 5: Cabling Specifications

2.4. Foreground and Background Services

Background and foreground services are important on a network for the communication of data. Background services such as protocols ensures that data is being sent and delivered to correct devices while foreground services provide solutions for the management and storing of data.

This section focuses on network foreground and background services used in the implemented network. Foreground service performs operations that is noticeable to users. Background services perform services which are not directly noticeable to users.

2.3.1. Foreground Services

a. Database management system (DBMS)

'DBMS is system software for creating and managing databases. The DBMS provides users and programmers with a systematic way to create, retrieve, update and manage data' [11].

The business can improve data consistency by sharing database resources throughout a network. Employees will be able to use the service to access the latest records of information. DBMS uses many protocols.

b. Electronic Mail (E-Mail)

Holland [12] describes the differences between Webmail and E-Mail. Webmail is accessible over a web browser whereas an E-Mail Client is a desktop program which provides users access to their webmail without the need of a browser. The business can benefit from the services provided by an E-Mail Client. Employees will be able to communicate internally (through the E-Mail Server) and externally (through the internet) without the need of aural communication. Internet Message Access Protocol (IMAP) and POP3 (Post Office Protocol 3) can be used to transmit mail.

c. File Server / Print Server

Yegulalp [13] argues a file and print server is a computer which provides file storage and printer services to other computers on a network.

The business can benefit from a file and print server. Files can be shared and worked on collaboratively by employees. Printers can be shared by multiple workstations throughout the business. File servers can use an FTP/S protocol to transfer files. Printers use TCP/IP.

2.3.2. Background

a. Transmission Control Protocol/Internet Protocol (TCP/IP)

Pranab [14] writes that TCP/IP is a protocol used to interconnect devices. TCP identifies how data is exchanged by establishing end to end communication then specifying how the data is packetized, addressed, transmitted then routed to the destination. The IP establishes the address and route packets make to reach devices. In TCP, Information is broken up into packets which are addressed, transmitted and then reassembled at the destination. TCP when sending information uses a term called windowing. Windowing starts by sending a segment of data, once the segment of data has been received and acknowledged two segments of data is sent, once received and acknowledged, 4 segments are sent. The cycle continues until the transmission is complete. If the recipient fails to receive some packets the cycle process starts all over again [15]. TCP/IP is mandatory to help the business with the communication between devices.

b. Domain Name Services (DNS)

Pfeiffer [16] in an article writes that a DNS maps domain names (address of a website, e.g. www. arden.ac.uk) to an IP address. Computers use IP addresses to communicate with websites over the internet. When a website domain name is entered into an internet browser the computer uses a DNS to establish what IP

address is mapped to the requested domain. The IP address is then used to retrieve the requested webpage. A DNS is necessary to help the business to communicate with other domains.

c. Dynamic Host Configuration Protocol (DHCP)

DHCP is used to dynamically assign IP addresses. Devices need a unique local IP address to communicate with other devices on a network. IP addresses can be allocated manually but this is not feasible to a network with many devices. Indiana University [17] argues, for devices to be dynamically given an available IP address the following steps are taken. 1. DHCP Discover: Device broadcast a message requesting to lease an IP address 2. DHCP Offer: A DHCP server offers an IP address to the device 3. DHCP Request: Device acknowledges and accepts the provided IP address 4. DHCP Ack: the DHCP server allocates the device with a leased IP address.

As depicted in an article by Mens [18] A DHCP server stores leased IP addresses and gives them lease times. A lease time is a set period in which a device can use an allocated IP address. Devices need to renew the lease to increase the lease time. If a device does not renew the lease (device is switched off) and the lease time expires, the IP address will return to a pool of available addresses. DHCP is necessary to the business to automatically provide dynamic IP addresses to devices on the network.

d. File Transfer Protocol (FTP)

Christensson [19] argues that FTP is a protocol which is used to transfer files. An FTP server can configure file transfers to specific users or give users read-only rights. FTP is not secure, so it is vulnerable to attack. FTPS (FTP with SSL Security) provides encryption for FTP protocols, making FTPS more secure.

The business could use the FTPS protocol on the network to help configure and secure files across the network securely without worrying about protocol analyzers. Protocol analyzers are tools to monitor network traffic, however they can also be used by hackers [20].

3. Network Monitoring

Network monitoring allows businesses to administer networks health and monitor the traffic on the network. Network monitoring provides valuable information to diagnose faults and administer the company's data communication traffic. This section explores widgets on a network monitoring tool by Solarwinds and explains their functionality that could be utilized in the communication network developed for the business. The Utilization widget displays a list of monitored interfaces. The widget shows a percent utilization for the monitored interfaces by displaying the receiving and transmitting information.

a. Hardware Health

The hardware health widget visualizes an overview of the network's hardware health. Nodes which have issues can be flagged by warnings.



Figure 6: Hardware Health [21]

b. Switch Stacks

The switch stack widget displays a list of switch stacks in the monitored network. 'A switch stack is a set of up to 8 switches connected through their stacking ports' [22]. The widget displays the usage of the switch stacks.



Figure 7: Switch Stacks [21]

c. Wireless Heat Maps

Wireless heat maps visualize wireless access point placements. The heat map is useful to visualise wireless signal strength throughout the network.



Figure 8: Heat Maps [21].

d. VLANs

The VLANs widget displays a list of VLAN's which are being monitored.



Figure 9: VLANs [21]

e. Errors

The Errors widget visualizes a list of high errors and discards for the day's activity. Errors include Discards and transmission errors. The widget highlights devices which are experiencing data packet receiving or transmitting errors or discards.

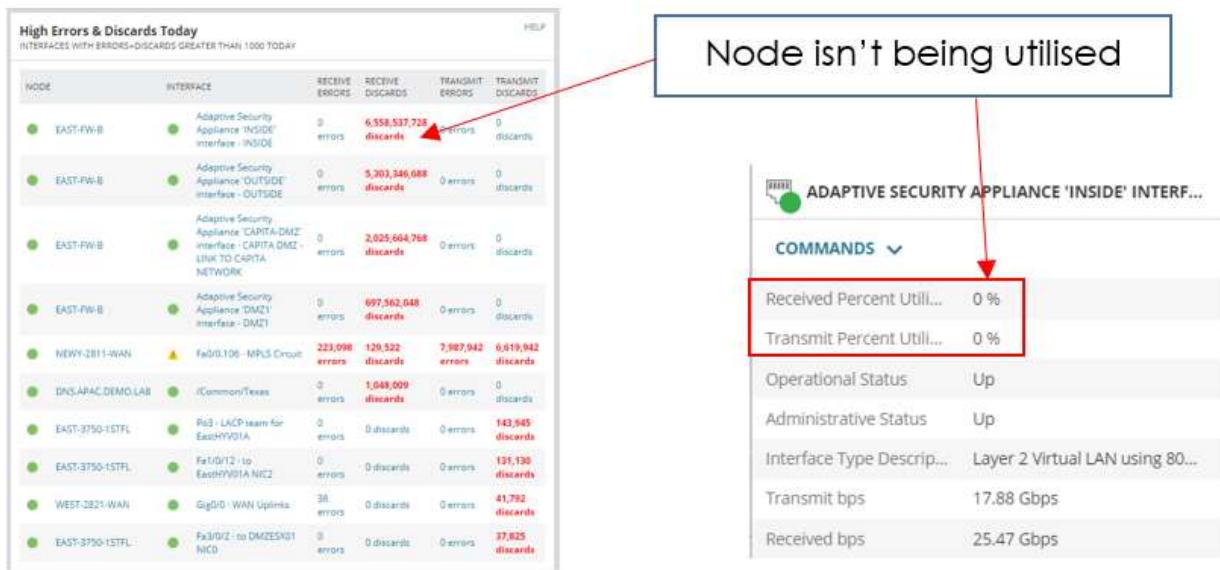


Figure 10: Errors [21]

f. Virtual Routing Forwarding (VRF)

The VRF widget displays a list of VRF's. '(VRF) is a technology included in IP network routers that allows multiple instances of a routing table to exist in a router and work simultaneously' [23].

List of all VRFs		
ROUTE DISTINGUISHER	VRF NAME	RECORDS
Management	MGMT	WEST-2821-WAN
	MGMT	EAST-2821-WAN
	mgmtVrf	EAST-4506E-CORE
	MGMT	LOSA-2821-WAN
	Mgmt-vrf	WEST-3850-CORE
	MGMT	WEST-3850-CORE
	MGMT	NEWY-2811-WAN

Figure 11: VRF [21]

g. Posts

The post widget displays a list of recent posts which have been posted by the online Solar Winds community.

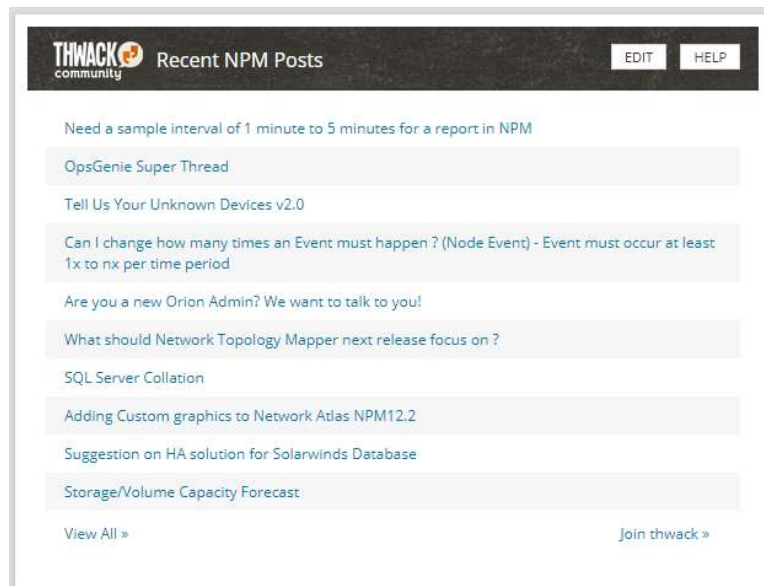


Figure 12: Posts [21]

h. Events

The event widget provides a detailed list of time stamped occurrences on the monitored network devices.

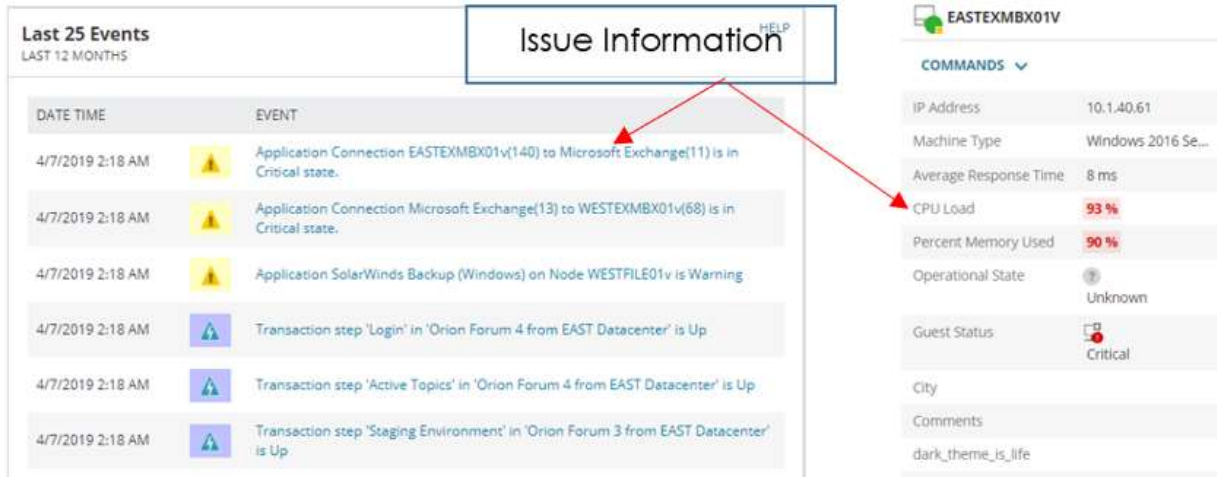


Figure 12: Events [21]

i. Network Map

The Network Map widget displays the entire network. This map has connected WANs (Wide Area Networks).

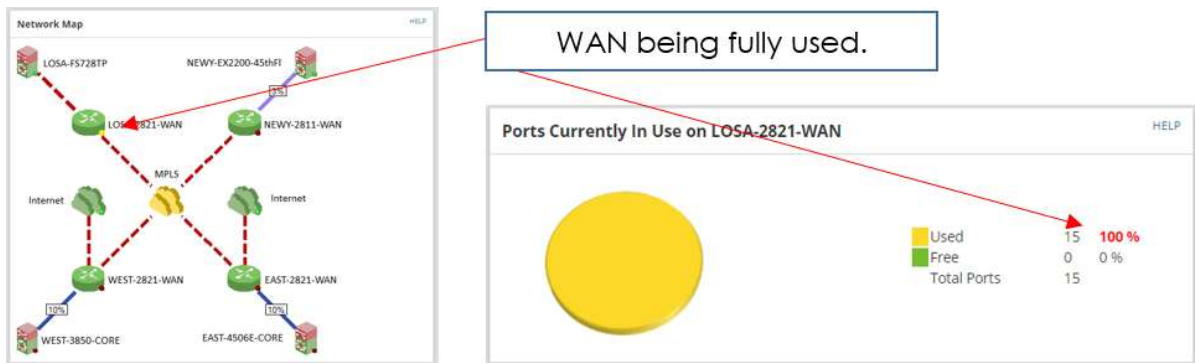


Figure 14: Maps [21]

4. Security Proposal for the Network

This section focuses on security issues, some of the possible threats to a network and the appropriate levels of protection.

a. Physical Security, Data Backup and Recovery

Hardware can be subject to theft or physical damage. Server cabinets, server rooms and workstations can be secured by locks. Server rooms should be cooled and ventilated to prevent devices from overheating. Video surveillance cameras may help with break-ins and to deter unauthorized access.

Company data can be backed up in case of theft, deletion or damages. Data should be off-site in case of disasters such as fires. Businesses such as 'SolarWinds Backup' provide services that can backup and recover lost data over the cloud. Backups can also be achieved manually by employees. Data can be backed up to storage mediums which are then taken off-site. Backed up data in this context should be encrypted. It is recommended that backups are taken at least weekly with daily being more favourable. A rotation of backup mediums should be taken weekly, monthly and then annually as depicted in an article by Cooke [24].

b. Authentication and Authorisation

Authentication: Usernames and passwords help authenticate users to devices. To help prevent unauthenticated access, workstations and other devices should have private strong passwords. Passwords can be breached and are vulnerable to attacks. Employee awareness and company policies can play a role in the prevention of exposure. Prevention can be achieved by employees never writing down or sharing their password. Passwords should be strong and include numbers, special characters, capital and lowercase letters. Strong passwords help to prevent unauthorized access from brute force attacks as depicted in an article by Vigliarolo [25].

Authorisation: Authorisation is setup differently depending on the operating system being used. Typically, users can be given authorization privileges to access certain services such as printers, system controls and file directories. Authorisation is achieved by setting up network control access with software such as Active Directories. The business could use authorization to help with the security of data.

c. Protection against Malware

Malware is software which can damage, provide unauthorized access or disrupt services on computers and throughout networks. Shah [26] writes about digital threats such as viruses, worms, Trojan horses, and spyware. There are many ways to protect devices against Malware, some of which are listed below.

Antivirus software: 'In the PC protection section, the aim of the antivirus is scanning files, finding malwares such as viruses, Trojans, worms and finally deleting them from the system' [27, p. 1326].

Firewalls: Firewalls are software or hardware devices that can filter incoming traffic. Hardware devices prevent unwanted packets from passing through to other devices on the network by applying rules. Software firewalls filter incoming threatening traffic from the internet [28].

Software Updates: Software updates help to fix bugs and security holes. Keeping software up to date can help prevent devices from malware and security threats. Our malware protection recommendation is Avast End Protection x15 devices.

5. Conclusion

I recommend growing businesses to invest in data communications if their business is having data communication issues. The purchasing and installation of networking infrastructure can be time-consuming, expensive and require administration however the benefits outweigh the negatives. Data consistency is a key advantage for companies to remain competitive and for staff work to work with consistent updated information. Businesses should also be aware of security issues of their data communication and take necessary steps to safeguard their data from attacks.

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